

What is claimed is:

1. A computer-assisted 3D imaging method for a wireless, capsule-type endoscope unit equipped with a video camera, comprising:

recording images of surroundings of the endoscope unit;

transmitting image data of the recorded images, in a wireless fashion, from the endoscope unit to at least one of a reception device and evaluation device;

executing a pattern recognition algorithm for identifying substantially corresponding features of successive individual images of a recorded image sequence; and

carrying out an image processing procedure for the concatenation of individual images by superimposing the identified, substantially corresponding image features in order thereby to produce a pseudo three-dimensional representation of the surroundings of the endoscope unit.

2. The computer-assisted 3D imaging method as claimed in claim 1, wherein, with each i -th recording, the position of the endoscope unit is detected and transmitted together with the image data to the reception and evaluation device and is digitally stored therein, i being a whole number greater than or equal to one.

3. The computer-assisted 3D imaging method as claimed in claim 1, wherein at least one of the position and orientation of the capsule-type endoscope unit is detected and inserted into the pseudo three-dimensional representation visualized via a display device.

4. The computer-assisted 3D imaging method as claimed in claim 1, wherein different camera perspectives of the surroundings of the endoscope unit are displayed by navigating a cursor in a control window of an operator interface, represented on a display device, of a computer program.

5. The computer-assisted 3D imaging method as claimed in claim 4, wherein the navigation is performed by way of input parameters.

6. The computer-assisted 3D imaging method as claimed in claim 1, further comprising:

calculating distance squares ($d_{ij}^2 := d^2(\underline{x}_{Mi}, \underline{x}_{Rj})$) between the image parameters, stored in the form of N -dimensional feature vectors (\underline{x}_{Mi}), of recorded individual images with the image parameters, stored in the form of N -dimensional reference vectors (\underline{x}_{Rj}), of images of diseased tissue structures from a reference image database by calculating the square of the Euclidean length ($\|\Delta \underline{x}_{ij}\|_2$) of their difference vectors ($\Delta \underline{x}_{ij} := \underline{x}_{Mi} - \underline{x}_{Rj}$); and

determining the reference vectors (\underline{x}_{Rj}) of the reference images whose distance squares (d_{ij}^2) are a minimum in relation to the respective feature vectors (\underline{x}_{Mi}) of the individual images to be examined.

7. The computer-assisted 3D imaging method as claimed in claim 1, wherein the pseudo three-dimensional representation of the surroundings of the endoscope unit visualized via a display device, is inspectable in the course of a virtual endoscopy by varying the viewing perspective with the aid of control signals of an input unit.

8. The computer-assisted 3D imaging method as claimed in claim 1, wherein, for concatenation of two individual images (m, n), use is made of the path difference ($\Delta \underline{x}_{m,n} := \underline{x}_n - \underline{x}_m$), covered by the capsule-type endoscope unit and loaded with a weighting factor, between the instantaneous recording positions ($\underline{x}_m, \underline{x}_n$) of the unit for recording the two individual images (m, n).

9. The computer-assisted 3D imaging method as claimed in claim 8, wherein instantaneous recording positions ($\underline{x}_m, \underline{x}_n$) of the capsule-type endoscope unit are determined by evaluating X-ray pictures in which the endoscope unit is identifiable.

10. The computer-assisted 3D imaging method as claimed in claim 8, wherein instantaneous recording positions ($\underline{x}_m, \underline{x}_n$) of the capsule-type endoscope unit are determined by evaluating the signal transit times (T_m, T_n) of the wireless image data transmission from the endoscope unit to the reception device.

11. A wireless endoscope unit in the form of a swallowable capsule, comprising

an integrated camera for recording a sequence of individual images;

a transmitter for wireless transmission of image data of the recorded images to a reception device and evaluation device; and

a permanent magnet, provided in the capsule, via which the endoscope unit is actively movable in a wireless fashion upon application of a temporally varying external magnetic field.

12. A medical apparatus for recording and evaluating signals from a capsule-type endoscope unit, comprising:

a reception unit for wireless reception of image information transmitted by the capsule-type endoscope unit;

a computation unit for decoding the image data transmitted by the capsule-type endoscope unit and for carrying out an image conditioning process for producing a pseudo three-dimensional representation of received image information; and

a display device for visualizing the conditioned image data.

13. The medical apparatus as claimed in claim 12, further comprising a magnet tube, including field coils for generating a stationary homogeneous magnetic field (\vec{B}_0), and one gradient coil, each with an associated gradient amplifier for three Cartesian space coordinates x , y and z for locally changing the magnetic field in the $\pm x$ -, $\pm y$ - and/or $\pm z$ - directions.

14. The medical apparatus as claimed in claim 12, further comprising:

a distributed arrangement of metal sensors for locating metal parts of the capsule-type endoscope unit; and

a measuring sensor, connected to the sensor arrangement, including a transponder as an interface between the sensor arrangement and the computation unit.

15. The computer-assisted 3D imaging method as claimed in claim 2, wherein at least one of the position and orientation of the capsule-type endoscope unit is detected and inserted into the pseudo three-dimensional representation visualized via a display device.

16. The computer-assisted 3D imaging method as claimed in claim 4, wherein the navigation is performed by way

of input parameters including magnitude of an advancing movement in a direction of movement of the capsule-type endoscope unit, and magnitude of rotary movement about an axis pointing in the direction of movement.

17. The computer-assisted 3D imaging method as claimed in claim 2, further comprising:

calculating distance squares ($d_{ij}^2 := d^2(\underline{x}_{Mi}, \underline{x}_{Rj})$) between the image parameters, stored in the form of N -dimensional feature vectors (\underline{x}_{Mi}), of recorded individual images with the image parameters, stored in the form of N -dimensional reference vectors (\underline{x}_{Rj}), of images of diseased tissue structures from a reference image database by calculating the square of the Euclidean length ($\|\Delta \underline{x}_{ij}\|_2$) of their difference vectors ($\Delta \underline{x}_{ij} := \underline{x}_{Mi} - \underline{x}_{Rj}$); and

determining the reference vectors (\underline{x}_{Rj}) of the reference images whose distance squares (d_{ij}^2) are a minimum in relation to the respective feature vectors (\underline{x}_{Mi}) of the individual images to be examined.

18. The computer-assisted 3D imaging method as claimed in claim 3, wherein the pseudo three-dimensional representation of the surroundings of the endoscope unit visualized via the display device, is inspectable in the course of a virtual endoscopy by varying the viewing perspective with the aid of control signals of an input unit.

19. The computer-assisted 3D imaging method as claimed in claim 4, wherein the pseudo three-dimensional representation of the surroundings of the endoscope unit visualized via the display device, is inspectable in the course of a virtual endoscopy by varying the

viewing perspective with the aid of control signals of an input unit.

20. The computer-assisted 3D imaging method as claimed in claim 6, wherein, for concatenation of two individual images (m, n), use is made of the path difference ($\Delta \underline{x}_{m,n} := \underline{x}_n - \underline{x}_m$), covered by the capsule-type endoscope unit and loaded with a weighting factor, between the instantaneous recording positions ($\underline{x}_m, \underline{x}_n$) of the unit for recording the two individual images (m, n).

21. The computer-assisted 3D imaging method as claimed in claim 2, wherein, for concatenation of two individual images (m, n), use is made of the path difference ($\Delta \underline{x}_{m,n} := \underline{x}_n - \underline{x}_m$), covered by the capsule-type endoscope unit and loaded with a weighting factor, between the instantaneous recording positions ($\underline{x}_m, \underline{x}_n$) of the unit for recording the two individual images (m, n).

22. The computer-assisted 3D imaging method as claimed in claim 21, wherein the instantaneous recording positions ($\underline{x}_m, \underline{x}_n$) of the capsule-type endoscope unit are determined by evaluating X-ray pictures in which the endoscope unit is identifiable.

23. The computer-assisted 3D imaging method as claimed in claim 21, wherein the instantaneous recording positions ($\underline{x}_m, \underline{x}_n$) of the capsule-type endoscope unit are determined by evaluating the signal transit times (T_m, T_n) of the wireless image data transmission from the endoscope unit to the reception device.

24. The medical apparatus as claimed in claim 13, further comprising:

a distributed arrangement of metal sensors for locating metal parts of the capsule-type endoscope unit; and

a measuring sensor, connected to the sensor arrangement, including a transponder as an interface between the sensor arrangement and the computation unit.

25. A 3D imaging method for a wireless, capsule-type endoscope unit equipped with a video camera, comprising:

identifying substantially corresponding features of successive individual images of a recorded sequence of images of surroundings of the endoscope unit; and

concatenating individual images by superimposing identified, substantially corresponding image features in order thereby to produce a pseudo three-dimensional representation of the surroundings of the endoscope unit.

26. The method of claim 25, wherein image data of the recorded images are transmitted, in a wireless fashion, from the endoscope unit to at least one of a reception device and evaluation device

27. The method of claim 25, wherein a pattern recognition algorithm is executed to identify the substantially corresponding features of successive individual images.

28. A wireless endoscope unit in the form of a swallowable capsule, comprising

a video camera for recording a sequence of individual images;

a transmitter for wireless transmission of image data of the recorded images; and

a permanent magnet, provided in the capsule, via which the endoscope unit is actively movable in a wireless fashion upon application of a temporally varying external magnetic field.

29. A 3D imaging system for a wireless, capsule-type endoscope unit equipped with a video camera, comprising:

means for identifying substantially corresponding features of successive individual images of a recorded sequence of images of surroundings of the endoscope unit; and

means for concatenating individual images by superimposing identified, substantially corresponding image features in order thereby to produce a pseudo three-dimensional representation of the surroundings of the endoscope unit.

30. A medical apparatus for recording and evaluating signals from a capsule-type endoscope unit, comprising:

means for wireless reception of image information transmitted by the capsule-type endoscope unit;

means for carrying out an image conditioning process for producing a pseudo three-dimensional representation of the received image data; and

means for displaying the conditioned image data.

31. A wireless endoscope unit in the form of a swallowable capsule, comprising

means for recording a sequence of individual images;

means for wireless transmission of image data of the recorded images; and

means, provided in the capsule, for actively moving the endoscope unit in a wireless fashion upon application of a temporally varying external magnetic field.